

Emergency Shelters

SEEK REFUGE
*Your Third Line
of Defense*



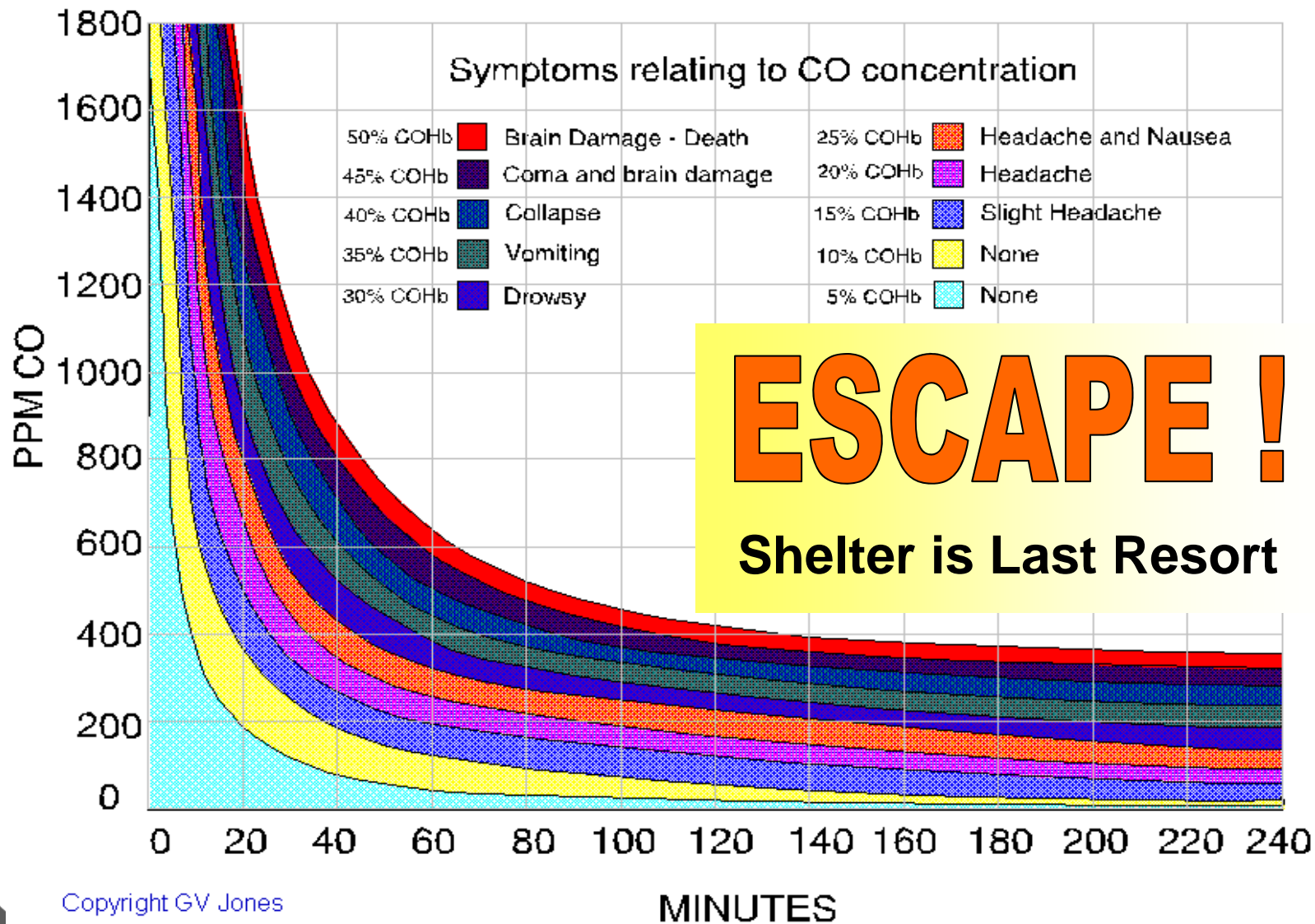
**A Technology Transfer Seminar
Greensburg, PA
MAY 27, 2010**



Randall Harris

W. Va. Office of Miners' Health Safety and Training
May 27, 2010

Carbon Monoxide Kills



WV §56-4



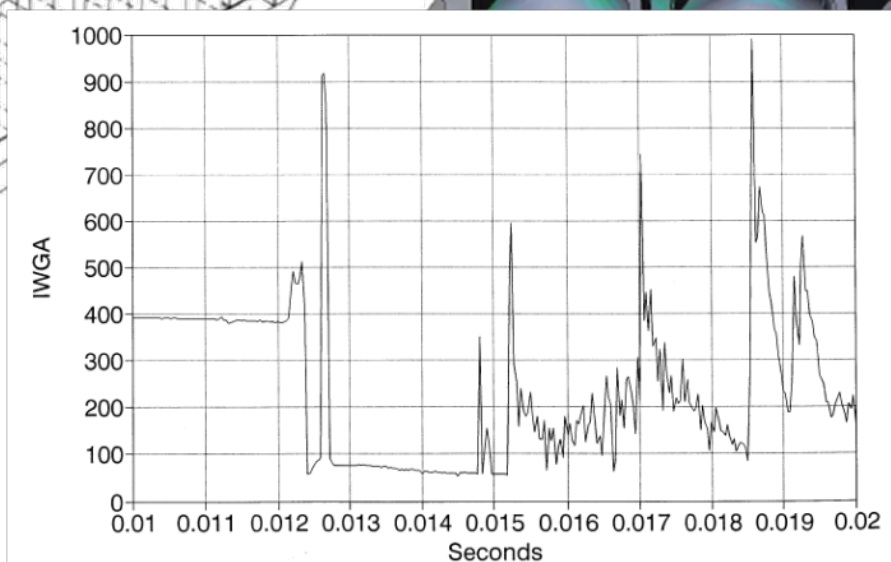
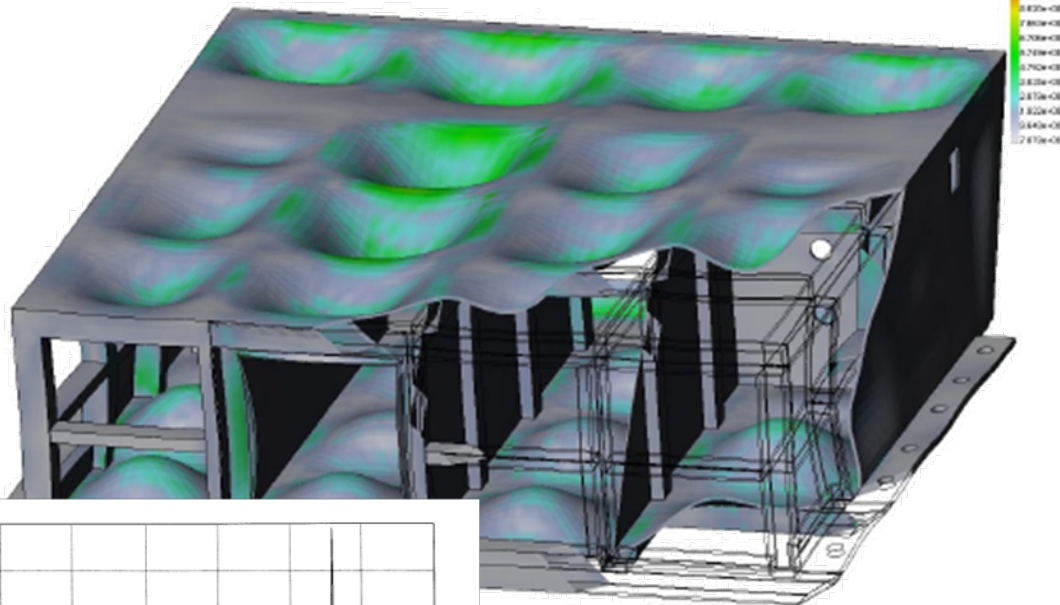
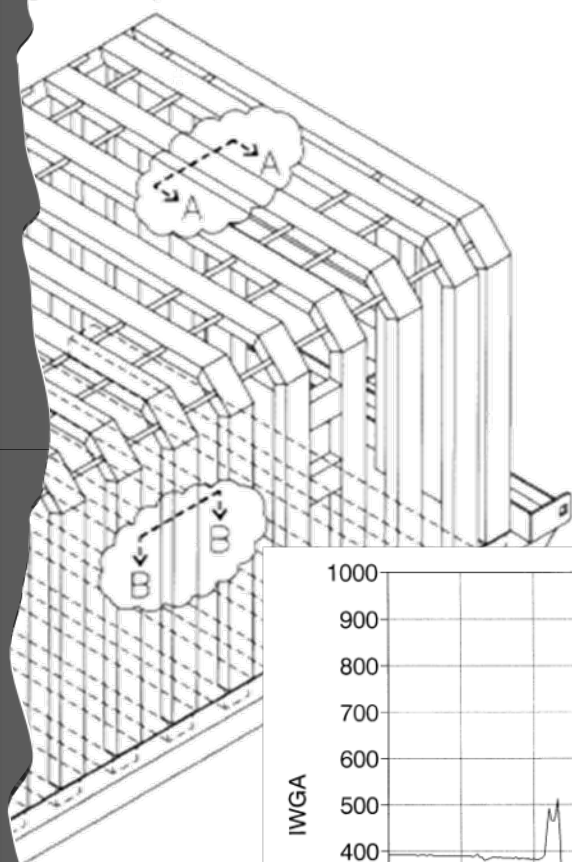
- Provide an alternative to barricading for miners who have tried to escape and couldn't – **SHELTER IS LAST RESORT**
- Within 1,000 feet of working face
- Provide life-support for maximum likely number of miners on section
- Currently approved 8 models from 7 all undergoing MSHA national approval testing
- Shelter Plans submitted 4-16-2007 last shelter delivered 10-2009

Structural Requirements



Overpressure Pressure: Static Solid Stress
15000 psi Deformation Scale: 200.000

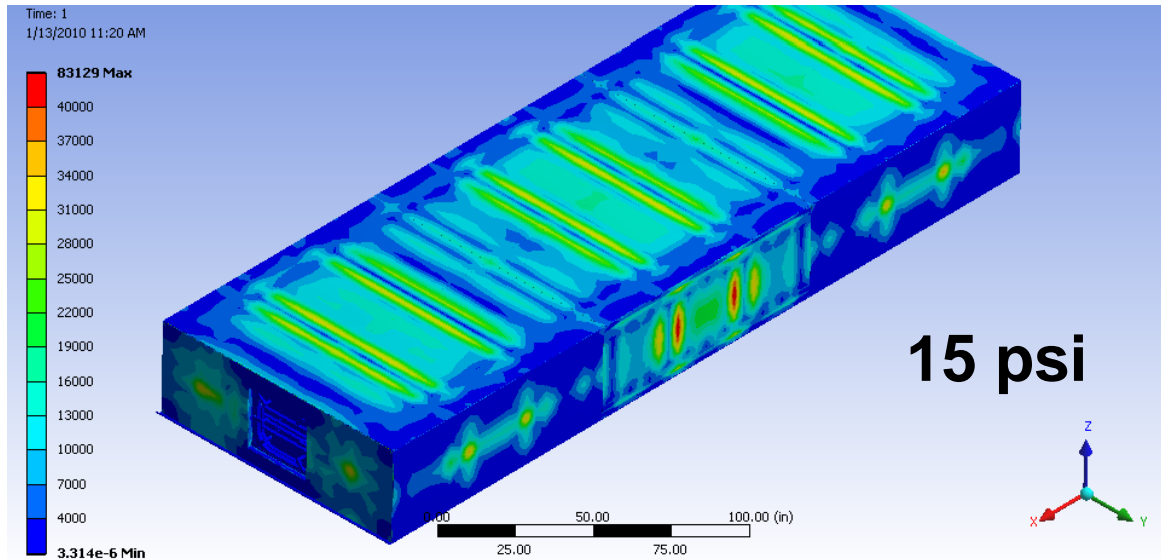
15 psi with 10x exaggeration of deformation



15 PSI Overpressure

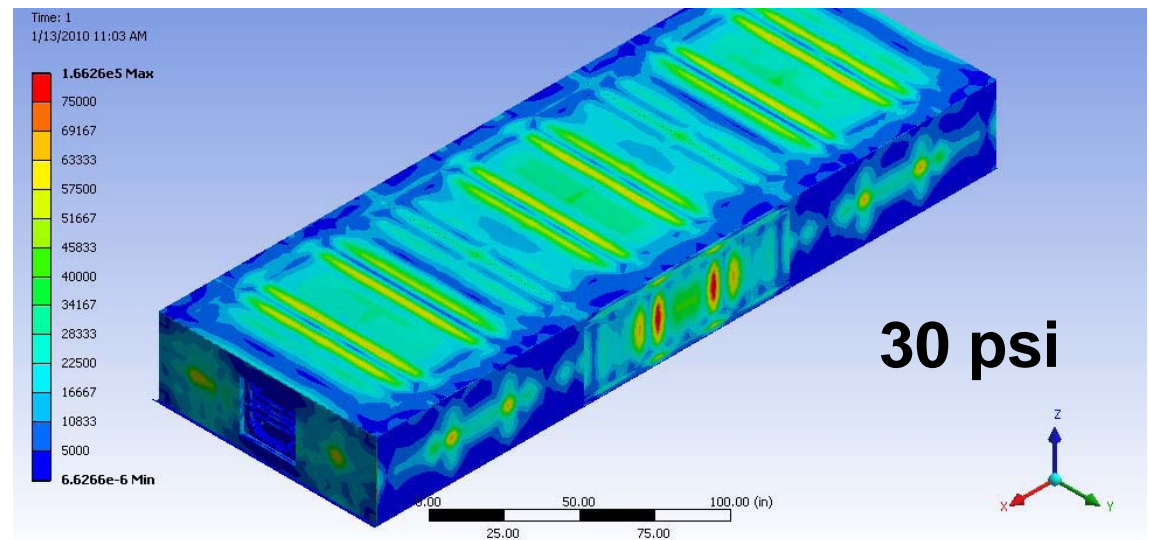
300°F Flash Fire

Structural Testing



**Computational
Finite Element
Modeling
Required**

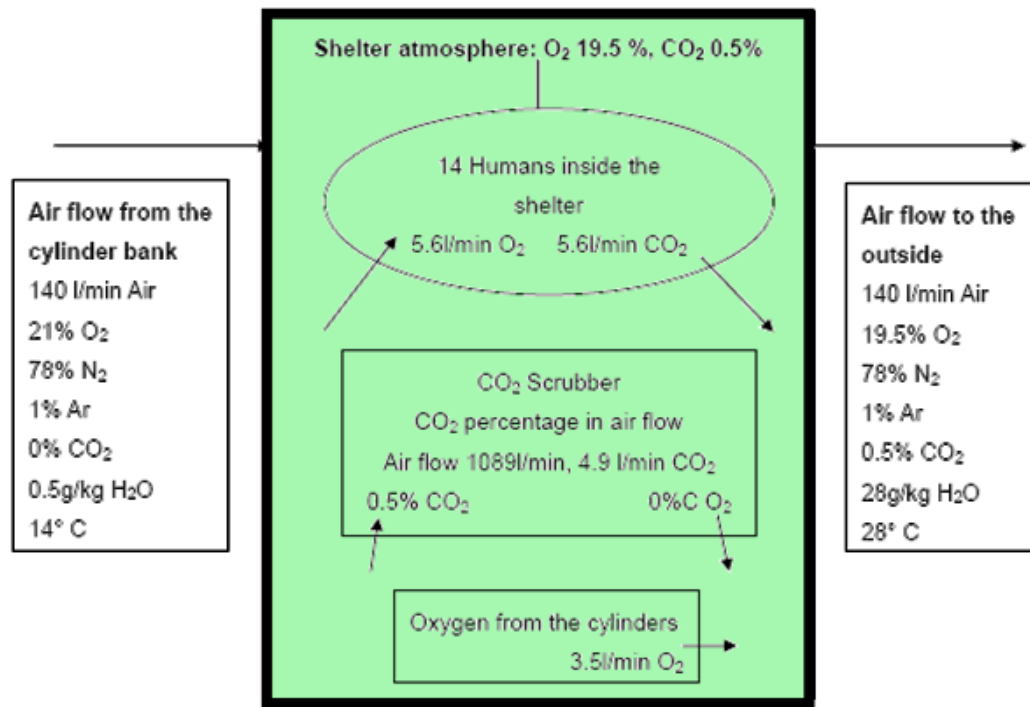
**Results have
been validated by
subsequent
physical testing**



Life-Support Requirements



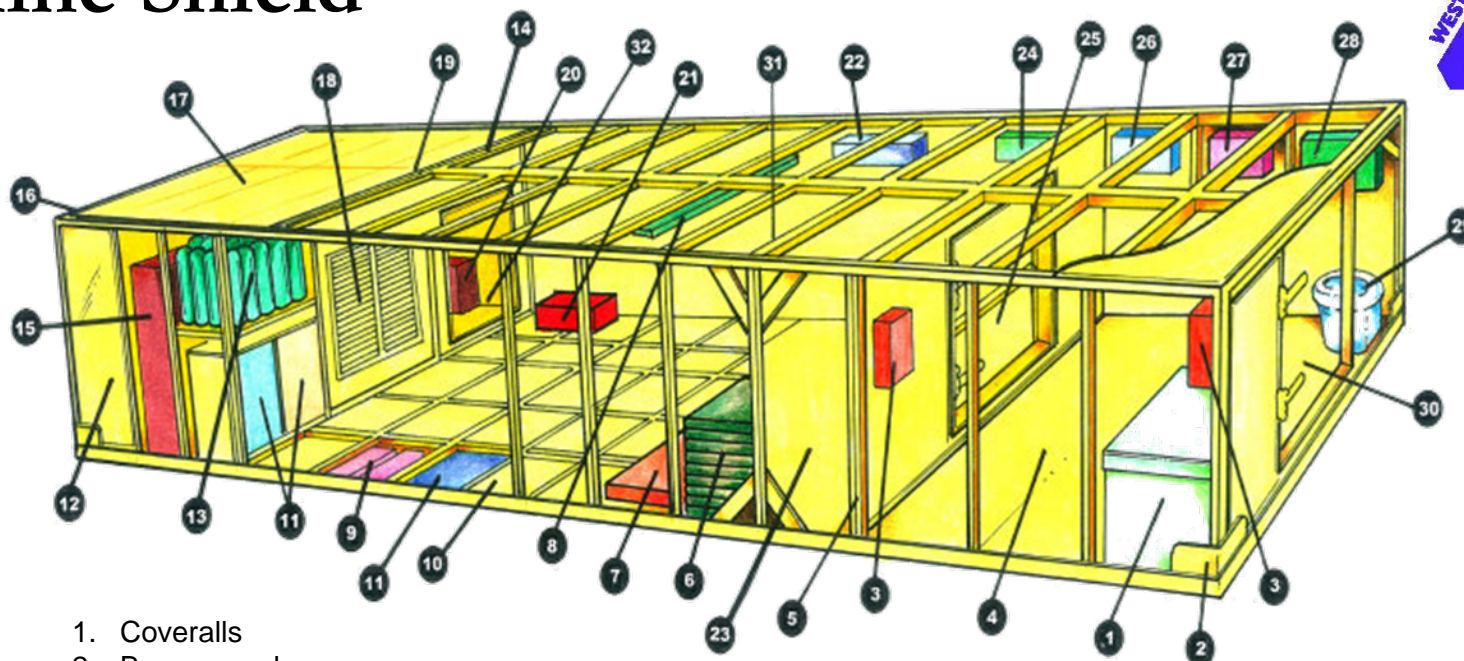
consumption of oxygen (O ₂)	0,4 l/min	(person in a rested mode)
output of CO ₂	0,4 l/min	(person in a rested mode)
Respiratory quotient	1.0	(uptake of O ₂ is equal to CO ₂ production)
heat emission	100 W	(constant between 25°C and 30°C)
humidity emission	1,5 l/ day	(person in a rested mode)



**Asked for
Minimum 48 hours**

Got 96 hours plus

Mine Shield™

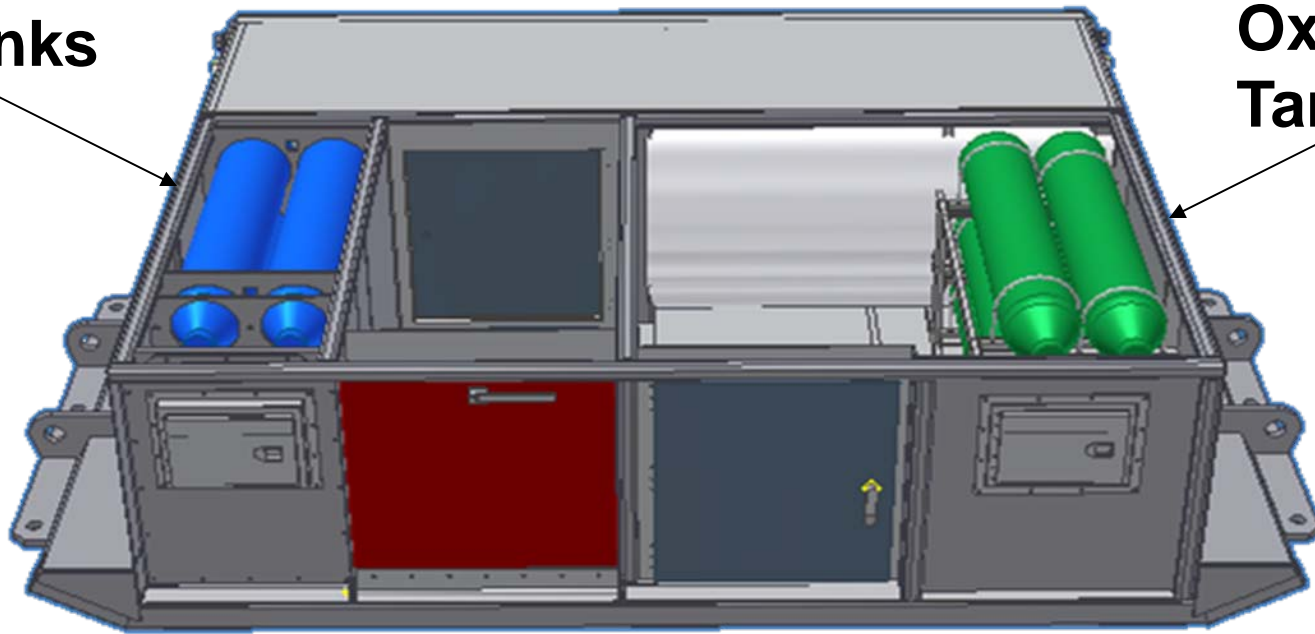


- | | | |
|---|----------------------------|------------------------------|
| 1. Coveralls | 17. Modular Construction | 31. Sliding Tray With Mounts |
| 2. Bumper pads | 18. Circulating System | 32. Gas Monitoring System |
| 3. Communication System | 19. Battery Packs | 33. Additional Storage |
| 4. Airlock Chamber | 20. 20. Repair Kit | 34. Outside Gas Sensor |
| 5. Reinforced Steel Construction | 21. 21 First Aid Equipment | 35. Air Tight Door |
| 6. Padded Cushion | 22. Gas Monitoring System | 36. Air Purge |
| 7. Additional Soda Lime Cartridges | 23. Additional Storage | 37. Gas Monitor |
| 8. Led Lights | 24. Outside Gas Sensor | 38. Purge System |
| 9. I pod, games, etc | 25. Air Tight Door | 39. Chemical Toilet |
| 10. Fitted panels | 26. Air Purge | 40. Air Tight Doors |
| 11. Food Storage | 27. Gas Monitor | 41. Sliding Tray With Mounts |
| 12. Powder coated panels inside and out | 28. Purge System | |
| 13. Tanks | 29. Chemical Toilet | |
| 14. Reinforced Roll Cage | 30. Air Tight Doors | |
| 15. Compressed Air / Manifold System | | |
| 16. Maintenance Door | | |

Packed Shelter

Air Tanks

Oxygen
Tanks



Oxygen, Food, Water & Additional Supplies

UBB



Strata Fresh Air Bay closest to tail piece was damaged with the corners turned up as if it was hit by a machine or other large debris.

The unit had been exposed to high temperatures as the paint was burned and peeled on parts of the unit.



Fresh Air Bay that were further away had apparent shrapnel (like hail storm) damage and some showed signs of heat buckling but no viable heat damage to paint.



It appears the units behaved as expected. The ones where survivors might have reached survived and the one where they could not have survived suffered their fate.

As soon as investigation allows they will be deployed and inspected.